The effects of persistent post-encoding processing on emotional retrieval

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Background

Memory performance for emotionally-charged events (and stimuli) has consistently been shown to be better than that for neutral events.[1,2] These effects of emotional valence have additionally been demonstrated as stronger for negative than positive events/stimuli.

One possible mechanism accounting for the emotional memory advantage is that neural activation of valenced stimuli persists for a longer period of time after the encoding presentation has ended, compared to that for neutral stimuli. This type of persistence has been shown in non-emotional contexts,[3,4] and we sought to extend it to the domain of emotional memory here.

In the current project, we set out to investigate the role of persistent reactivation in emotional memory. However, in our initial experiments using word stimuli[5] that varied in valence (neutral vs. negative) and arousal (low vs. high), we failed to observe the typical effect of emotional valence that has been often shown for picture stimuli. Here, we describe our initial findings and how our ongoing work is attempting to reconcile these discrepancies.

Methods

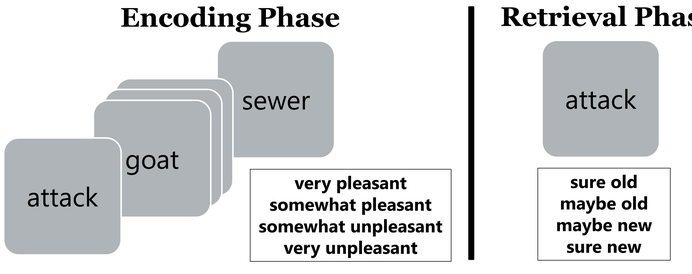
Subjects (N = 46; 54% women) from the MU undergraduate subject pool completed an **online experiment** (via Pavlovia) consisting of two study-test cycles and lasting approximately 40 minutes. Data were removed for subjects who performed near chance during the retrieval phase.

Encoding phase

- Each encoding phase consisted of 20 words drawn from each of four stimulus conditions (80 words total) that corresponded to crossing **emotional valence × arousal**: 1) *neutral, low arousal*; 2) *neutral, high arousal*; 3) *negative, low arousal*; and 4) *negative, high arousal*.
- Each word was shown for 1 sec, with a 2-sec ITI, and required a 4-point **pleasantness rating** (*very pleasant*, *somewhat pleasant*, *somewhat unpleasant*, or *very unpleasant*).

Retrieval phase

- Each retrieval phase included the 80 words from the preceding encoding phase along with 80 non-studied words (again drawn equally from the four stimulus conditions). Subjects made a **confidence judgment** for each test word on a four-point scale: *sure old*, *maybe old*, *maybe new*, or *sure new*. Trial timing was the same as in the encoding phase.



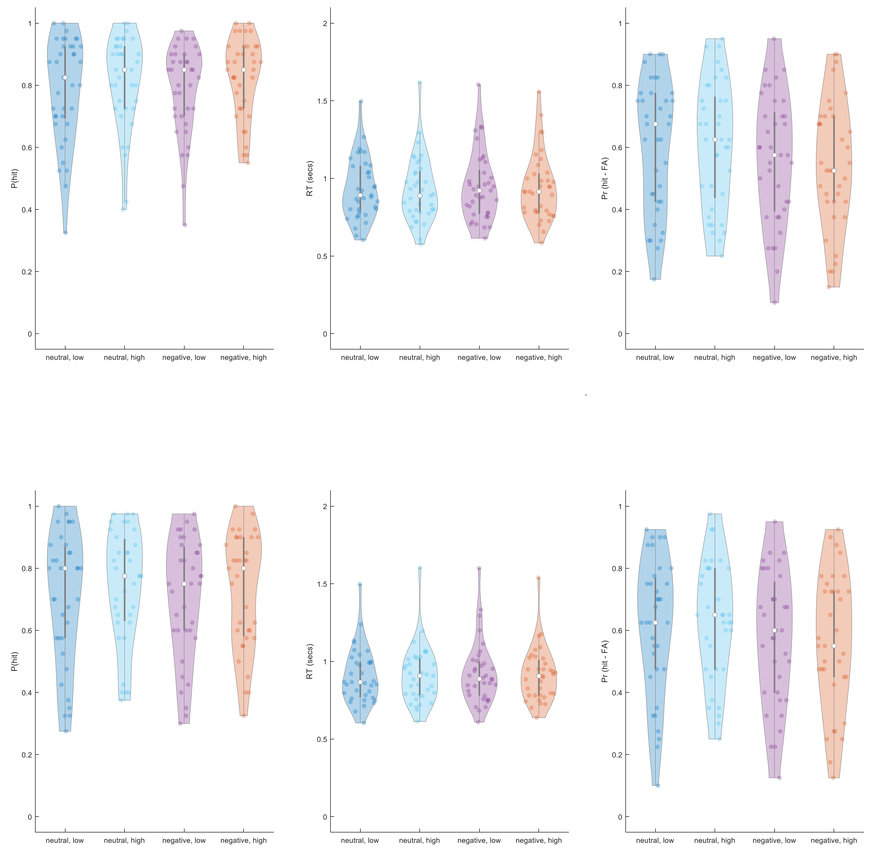
Results

Standard old/new recognition

- We first analyzed the data from the retrieval phase according to standard old/new recognition (collapsing over high and low confidence responses). As shown to the right, there was little evidence that performance was better (higher hit rates and accuracy, or faster RTs) for negative compared to neutral words.
  - Hit rates: arousal main effect ($F_{1,36} = 17.47$, $p < .001$)
  - Hit RTs: no significant effects
- Corrected recognition accuracy (hit – FA, or *Pr*) was also computed, and revealed a significant effect of emotional valence ($F_{1,36} = 15.44$, $p < .001$). However, this effect was in the opposite direction to that predicted (i.e., negative < neutral).

High-confidence recognition

- Given that effects of emotional valence might be restricted to strong memories, we repeated the above analyses while considering only high-confidence (sure old) responses for hits and false alarms (FAs).
- For these analyses, the same pattern of results was observed.
  - Hit rates: arousal main effect ($F_{1,34} = 9.94$, $p = .003$)
  - Hit RTs: no significant effects
  - Pr: valence main effect ($F_{1,34} = 9.73$, $p = .004$), but again opposite to our prediction



Summary & ongoing work

- In this initial study of the effects of emotional valence and arousal on memory for word stimuli, we unexpectedly did not find evidence for the negative-valence advantage. Instead, our measure of recognition accuracy (Pr) showed the opposite effect, such that performance for neutral words was enhanced. Moreover, the predicted effect of arousal on memory (high > low) was observed on the hit rates.
- To address the null valence finding, our ongoing work involves replicating the experiment described here but with two main design differences.
  - First, we suspect that the pleasantness ratings might be simple (i.e., obvious) for negative stimuli and require more thought for neutral stimuli. If this is true, subjects could have spent more time encoding neutral stimuli, thus mitigating the typical valence effect. In an ongoing study, the encoding phase is using concrete/abstract judgments.
  - Second, it is possible that confidence judgments at retrieval do not encourage as elaborative encoding as remember/know judgments do. Since remember/know judgments have been more widely used in emotional memory studies with words, we have switched to doing so.
- Once we are able to establish the standard valence (and perhaps, arousal) effects with word stimuli, we plan to introduce a secondary task following each stimulus during the encoding phase. Such a task is expected to limit the persistent activation that might naturally occur more often for negatively-valenced compared to neutral events. Additionally, we plan to use EEG to better characterize the neural dynamics of reactivation during the encoding phase, with the ultimate goal of accounting for the emotional advantage in episodic memory.

References

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